Creating a Regional Sediment Management Geographic Information System (GIS)

GIS Implementation goals

To organize, develop and maintain various types of coastal data and resources into a comprehensive Geographic Information System (GIS).

US Army Corps
of Engineers
Mobile District
Operations Division
Spatial Data Branch

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Acquiring and Creating GIS Data

A GIS stores information about the world as a collection of themed layers that can be used together. A layer can be anything that contains similar features such as customers, buildings, streets, lakes, or postal codes.

This data contains either an explicit geographic reference, such as a latitude and longitude coordinate, or an implicit reference such as an address, postal code, census tract name, forest stand identifier, or road name.

To work, a GIS requires explicit references. A GIS can create these explicit references from implicit references by an automated process called "geocoding," or tying something like an address to a specific point on the earth.

To create maps using GIS, you need good data. For example, if you are trying to see the locations of your customers, you will use your database of customer addresses to make that map. You need to ensure those addresses are correct for the map to be useful.

Selecting the Right Data

As you search for data for your GIS, you will go through a process of making a wish list and investigating data that meets your criteria. Following are the most important issues you will need to consider to determine which data you need.

What do you want to do with the data?
Do you want to draw maps or do a certain type of analysis? Do you want to match customers to street addresses or to telephone exchange areas? Do you simply want to draw an accurate street map, or do you want to use the GIS software to develop delivery routes?

Consider carefully how you answer these questions because the answers will likely govern your answers to the following questions. Take into account your medium- or long-term goals as well as those you want to accomplish now.

1. What are the specific geographic features you need?
   To gain the most understanding from your GIS, determine the level of detail required from your data. For example, do you want all streets or major highways? If so, at what level of generalization—major highways at a "local" scale, such as 1:24,000, or at a "national" scale, such as 1:3,000,000. Even for a seemingly simple feature such as streets, you may need to decide how you want them represented (centerlines, double-lined streets, or connected routes).

2. What attributes of those features do you need?
   Using streets as an example, depending on your goals you will have to determine whether you need none, some, or all of the following attributes: street name, route number, road class, road surface class, address ranges, traffic volume, and under- or overpass.

3. What is the geographic extent of your area of interest?
   Data can be acquired for areas as small as a ZIP Code or census block or as large as the entire world. You will need to determine the size of the area for which you need data.

4. What is the level of geography you want to examine within your area of interest?
   Your area of interest can often be broken down into smaller areas. Within a state, for example, you may want to examine statistics by census tract, block group, ZIP Code, or cable TV area.

5. How current must the data be?
   For some applications, such as land use planning using remotely sensed imagery or aerial

photography, obtaining the latest data available is critical. For other applications, data that was collected a year or two before may be adequate.

6. What type of computing environment will you be using?
   Determine if you will be using Windows, Windows NT, Macintosh, UNIX workstations, or whether you will be working in a mixed environment.

7. What GIS software will you be using?
   The answer to this question may affect the data format you select.

8. How many concurrent users will be accessing the data, at how many locations?
   Single user, multiple individual users at one location, multiple users accessing a server, or single users at several regional offices are a few possible scenarios that may affect the type of data license you buy.

9. When do you need the data?
   Many "off-the-shelf" data sets can be acquired in a couple of business days, but if you need customized data sets, plan ahead. Orders that require customization may take up to several weeks to prepare and deliver.

10. Will you need periodic data updates and, if so, how frequently?
    Determine if complete replacements of the data are preferred or if you require transactional updates (changes only). Data publishers have different ways of handling data maintenance. Sometimes it is best to negotiate the maintenance schedule with the initial data license.

11. Which of the data sets identified may be licensed from the same data publisher?
    While it is possible to layer data sets from multiple data publishers and use them successfully, remember that data publishers typically develop their data sets independently and use different sources. Therefore, there is no guarantee that data sets from different publishers will overlay precisely or that feature identification attributes will be the same in different data sets. A common coordinate system is a consideration here.

    If your project is a large one (e.g., if you plan to obtain data for an entire country), you should seriously consider first testing your proposed data set combination (i.e., creating a prototype) on a small region such as one or a few counties.

12. Do you plan to start small, then expand?
    For a number of reasons, you may decide to start building your database for one metropolitan area or a few states, then expand your database to cover a state or the entire country. If so, what is your expected expansion schedule? The data publisher may be able to take this into consideration when pricing and licensing the data.

13. Do you want to publish derivative products with the data?
    If you plan to create hard-copy or printed maps that you will give away or sell, either within or outside your organization, this will affect how the data is licensed. Publishing the data on an Intranet or the Internet will also affect the license. Most data publishers restrict such redistribution in their license agreements. If you are unsure whether your intended use of the data is permitted, be sure to ask your marketing representative.

Choosing a Map Projection
[http://www.colorado.edu/geography/gcraft/notes/mapproj/mapproj_f.html]

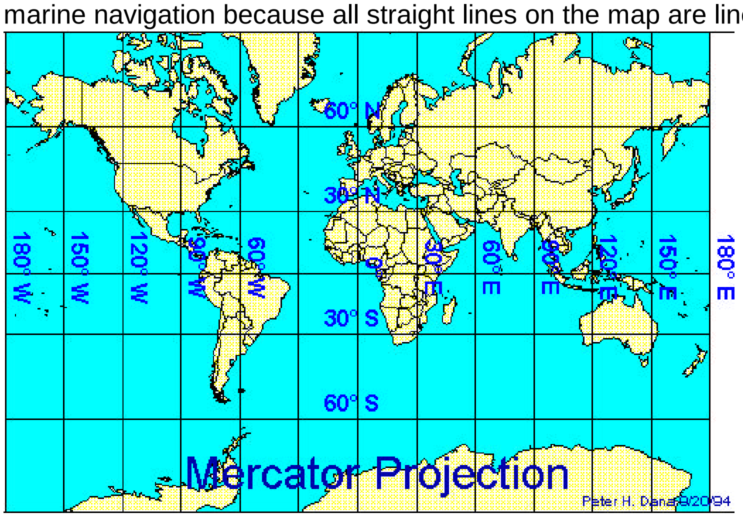
Map projections are attempts to portray the surface of the earth or a portion of the earth on a flat surface. Some distortions of conformity, distance, direction, scale, and area always result from this process. Some projections minimize distortions in some of these properties at the expense of maximizing errors in others. Some projections are attempts to only moderately distort all of these properties.

Conformity
When the scale of a map at any point on the map is the same in any direction, the projection is conformal. Meridians (lines of longitude) and parallels (lines of latitude) intersect at right angles. Shape is preserved locally on conformal maps.

Distance	A map is equidistant when it portrays distances from the center of the projection to any other place on the map.
Direction	A map preserves direction when azimuths (angles from a point on a line to another point) are portrayed correctly in all directions.
Scale	Scale is the relationship between a distance portrayed on a map and the same distance on the Earth.
Area	When a map portrays areas over the entire map so that all mapped areas have the same proportional relationship to the areas on the Earth that they represent, the map is an equal-area map.

Examples:

The **Mercator** projection has straight meridians and parallels that intersect at right angles. Scale is true at the equator or at two standard parallels equidistant from the equator. The projection is often used for marine navigation because all straight lines on the map are lines of constant azimuth.



The Universal Transverse Mercator **(UTM)** projection is used to define horizontal, positions world-wide by dividing the surface of the Earth into 6 degree zones, each mapped by the Transverse Mercator projection with a central meridian in the center of the zone. UTM zone numbers designate 6 degree longitudinal strips extending from 80 degrees South latitude to 84 degrees North latitude. UTM zone characters designate 8 degree zones extending north and south from the equator. Please see Appendix A to determine the proper UTM Zone for your region.

State Plane Coordinate System (SPCS) is a conformal projection and is suitable for medium and large scale maps. The SPCS is the system most commonly used by the state and local governments and by private surveyors. General uses of SPCS include the utilization of topographic, geologic, presentation and USGS data.

Albers is an equal area projection and is suitable for continental, regional and medium scale maps. Neither shape or linear scale is truly correct. This projection is best used for landmasses that extend more in the east-to-west orientation than those lying north-to-south.

Types of Data

Data Types and Models

Data for a GIS comes in three basic forms, all of which are demonstrated in the map to the right:

- Spatial data—what maps are made of
  Spatial data, made up of points, lines, and areas, is at the heart of every GIS. Spatial data forms the locations and shapes of map features such as buildings, streets, or cities. *(See Vector Data)*
- Tabular data—adding information to maps
  Tabular data is information describing a map feature. For example, a map of customer locations may be linked to demographic information about those customers. *(See Tabular Data)*
- Image data—using images to build maps
  Image data includes such diverse elements as satellite images, aerial photographs, and scanned data—data that's been converted from paper to digital format. *(See Raster Data)*

In addition, this data can be further classified into two types of data models:

This map shows vector data (the streets) laid on top of raster data (the mountains and valley floor).

- Vector data model
  Discrete features, such as customer locations and data summarized by area, are usually represented using the vector model.
- Raster data model
  Continuous numeric values, such as elevation, and continuous categories, such as vegetation types, are represented using the raster model.

Vector Data (point, line, polygon)

Vector data has both magnitude and direction. Vector graphics structure is a means of coding line and area information in the form of units of data expressing magnitude, direction and connectivity.

An example of vector data is a CAD file, such as Microstation or AutoCAD, or a graphic drawn in ArcView. A line drawn in a vector format is defined by co-ordinates at each end of the line or co-ordinates at the start point and direction and length of the line. As a result the size of a vector file is smaller than that required by a raster file.

A vector file will usually have a defined set of elements (e.g. lines, text, ellipses, shapes, curves, grouped complex elements, points) that can be used in the file.
[http://members.iinet.net/~cadres/vector.htm]

TIPS—TRICKS—HINTS

Download the **XTools** tools extension for ESRI's ArcScripts. [http://gis.esri.com/arcscripts/details.cfm?CFGRIDKEY=4D4DBAEA-25DA-11D4-942E00508B0CB419]. This extension is available for free download and is a valuable set of tools useful in vector spatial analysis, shape conversion and table tools.
Some available tools included are:

- Convert Graphics to Shapes
- Merge Themes
- Clip with Polygon
- Update Area, Perimeter, Acres and Length

Simple point shapefiles can be created quickly and easily from existing x, y, z ASCII point files. ArcView can only read comma-delimited files. To create a point file, Add in the comma-delimited table (*.txt, *.dbf) in the ArcView Table window. Go into a View and select the Create Event Theme option from the Theme menu. Select your table and the X and Y columns. When OK is selected, ArcView builds a point theme for the x,y,z points. To convert this temporary theme to a shapefile, have the newly created layer active and select the Convert to Shapefile option from the Theme menu.

Raster Data (imagery)

Raster data, or images, such as GIFs, JPEGs, MrSIDs, or TIFFs, are positioned in a view based on the attributes of the image pixels. To overlay raster data with real world vector data, images must be georeferenced to the same coordinate system.

Image formats may store georeferencing coordinates in the header of the image file (i.e. Erdas IMAGINE files, MrSID images, GeoTIFFs, Etc.) or in an additional file called a header file .hdr (i.e. BIL, BSQ, and BIP). For example the header of the image myimage.bil would be myimage.hdr.

Tabular Data

Tabular data for use in a GIS can be purchased already packaged with spatial data or it can be found in your own organization.

If you have lists, spreadsheets, or databases about information like customer lists, where offices are located, or others, you can use this information in a GIS. If you have the correct spatial data the GIS can link your tabular data, via an ODBC connection, with the spatial data. For example, you can create points on a map of office locations. Or you can link sales information with postal code areas, allowing you to map sales volume by postal code.

Tabular data you already own can be combined with tabular data for purchase to help analyze the data better. Perhaps you'd like to take your sales volume by postal code map and combine it with some commercially available data such as demographic statistics by postal code to profile each postal code community.

What is ODBC and DSN?

ODBC is a programming interface that enables applications to access data in a database management systems that use SQL (Structured Query Language) as a data access standard.

A Data Source Name (DSN) is the logical name that is used by Open Database Connectivity (ODBC) to refer to the drive and other information that is required to access data. The name can be used by ArcView for a connection to an ODBC data source, such as a Microsoft SQL Server database, Microsoft Excel or Microsoft Access. To set this name, use the ODBC tool in Control Panel (if uses Windows 2000, ODBC is located under Administrative Tools option).

When you use an ODBC DSN entry to store the connection string values externally, you simplify the information that is needed in the connection string. This makes changes to the data source completely transparent to the code itself.

To Create a System DSN (Win NT)

1. Click **Start**, point to **Settings**, click **Control Panel**, and then double-click **32-Bit ODBC**.
2. Click the **System DSN** tab.
3. Click **Add**.

4. Click the database driver that corresponds with the database ype with which you are connecting, and then click **OK**.
5. Type the data source name. Make sure to use a name that you will remember. You will need to use this name later.
6. Click **Select**.
7. Click the correct database, and then click **OK**.
8. Click **OK** in the next two dialog boxes.

To Create a System DSN (Windows 2000)

1. Click **Start**, point to **Settings**, click **Control Panel**, and then double-click **Administraive Tools** double-click **Data Sources (ODBC)**.
2. Click the **System DSN** tab.
3. Click **Add**.
4. Click the database driver that corresponds with the database t ype with which you are connecting, and then click **Finish**.
5. Type the data source name. Make sure to use a name that you will remember. You will need to use this name later.
6. Click **Select**.
7. Click the correct database, and then click **OK**.
8. Click **OK** in the next two dialog boxes.

Using DSN and ODBC in ArcView

The Database Access extension provides multi-user access to client-server databases as well as access to local flat file databases using Open Database Connectivity (ODBC). This extension provides an alternative to SQL Connect for accessing databases using ODBC in ArcView. A table created with this extension is called a database table and has tables from either an ODBC or SDE database as it's data source. Database tables are similar to regular tables, but have a few different properties.

Additional Avenue and Visual Basic classes are provided that allows you to develop ODBC client applications. You can write scripts or procedures to execute SQL statements, update the attributes of tables in your database or add and delete records in database tables. Classes are also available for retrieving error information from the ODBC driver, driver administrator or database.

ArcView Extensions

What are Extensions?

Extensions allow you to share customizations, documents, or any other objects in a project independent manner. Extensions are easily and intuitively used by anyone and can be created by anyone familiar with Avenue.

The Extensions dialog allows you to load and unload extensions. Extensions extend ArcView "on the fly" allowing you to enhance your working environment with additional objects, scripts and customization independent of the current project. You can use extensions provided by ESRI and you can also create your own. Extensions are a great way to share your favorite button or an interesting View document with your colleagues and because the extension installs its own components, even beginning ArcView users can easily use them.

Available Extensions list

The available extensions list includes all the extension files in the directory identified by $AVEXT and in the directory identified by $USEREXT (defaults to $HOME) (see setting Environment Variables).

NOTE: When downloading new extensions, copy them in the c:\ESRI\AV_GIS30\ARCVIEW\Ext 32 directory or in the directory defined by the $USEREXT variable.

Each extension in the list has a check box to the left of its name. You load and unload extensions by checking and unchecking the box.

What do the check marks and check boxes mean?

- No check mark in the check box means that extension is NOT loaded.
- A check mark in the check box means that extension is loaded.
- A solid check mark means that extension can be unloaded.
- An outlined check mark means that extension cannot be unloaded because of dependencies upon it.

To load an extension

1. Drag the mouse over the check boxes to the left of the extension name in the Available Extensions list. Notice the cursor turns into a check mark.
2. Click on the check box for the desired extension. When you check the box, a check mark will appear.
3. When you hit OK, that extension will be loaded.

NOTE: If the extension you checked is dependent upon another extension, the other extension will also be loaded. If the required extension is in your Available Extensions list, its check mark will be an outline instead of a solid - an outline check mark indicates the extension cannot be unloaded because of dependencies. If a required extension is not listed in your Available Extensions list, it will NOT be added to the list, but the extension will be loaded.

To unload an extension

1. Drag the mouse over the check boxes to the left of the extension name in the Available Extensions list. Notice the cursor turns into a check mark.
2. Click on a checked check box to remove the check mark. If a check mark is an outline (not solid), you cannot unload the extension because there are dependencies on it.
3. When you hit OK, ArcView unloads that extension.

OK	OK applies any changes and closes the dialog box.
Cancel	Cancel closes the dialog box, but does not apply changes.
Reset	Reset restores the loaded and unloaded states of all extension to the system default settings

SAM-OPJ Extensions

The SAM-OPJ and SAM-RSM extension has been included on this CD. Copy this extension into c:\ESRI\AV_GIS30\ARCVIEW\Ext 32 .

The SAM-OPJ Extension, loads the SAM-OPJ Tools menu into a View which includes the following functionality:

- Delete All Graphics
- Hide Table of Contents
- Set No Data Transparency
- Move Active Themes to Top
- Move Active Themes to Bottom
- Sort Table of Contents

This extension also loads 4 buttons with the following features:

- Allows a user to find features of theme through interactive selection of feature attributes queried from the feature table.
- Prints a quick formatted map of the current view, a user-specified print scale option is provided. A columnar report of user-specified fields from the theme's feature table is also printed.
- Prints a quick formatted map of the current view, a user-specified print scale option is provided. A columnar report of user-specified fields from the theme's feature table is also printed.
- Adds two new fields, named X-coord and Y-coord, to the table of the first active theme in the TOC and fills the respective fields with the X,Y coordinates of the selected points (or all points if no selection is defined) in a point theme.

An extra tool is also added to the toolbar which:

- Places the Easting and Northing coordinates in text boxes for copying and pasting into other application. View typically has projected data like a State Plane system.
- Returns the Latitude and Longitude of the selected point in an active view. If the View is projected the Easting and Northing is returned.

Environment Variables

Environment variables are strings consisting of environment information, such as a drive, path or filename, associated with a symbolic name that can be used by Windows NT. These variables can be incorporated in ArcView via scripts, so that projects can be viewed on any user's computer.

Example:
If you originally create an ArcView project entirely out of you C:\RSM_Project\ folder, e.g. all themes resides in this location, but since the project was last opened, your RSM_Project folder has moved to the D: drive. Before opening the project, in Control Panel (see directions below) change the existing HOME variable to D:\RSM_Folder.

How to Create Environment Variables:
To create an environment variable (Windows NT):
Click **Start**, point to **Settings**, click **Control Panel**, and then double-click **System**.
Click on the **Environment** tab.
Click on any path under the Systems Variable box.
Type in the **Variable** name, such as RSM_HOME.
Type in the variable **Value**, such as g:\gis_folder\rsm
Click on **Set**.

To Set ArcView Project Environment Variables:

How to Use Environment Variables:
Sample StartUp Script:
theImageName = system.**GetEnvVar**("RSMDD_HOME").AsString+"_sediment_dd\\digpics\\splash.gif"

Sample Data Dictionary:

Group_Name	Common_Name	File_Name	File_Path	Description
RSM - Sub-Region 01	Sub-Region 1 Streams and Rivers	rsm_dd_rivers_01.shp	$RSMDD_HOME/_sediment_dd/feature/shape/regional/zone_01	Streams and rivers within Sub-Region1
RSM - Sub-Region 01	High Water Line 001 - FDEP 1998	hwl00101.shp	$RSMDD_HOME/_sediment_dd/feature/shape/shoreline/highwater/zone_01/	High waterline digitized from Florida DEP 1998 Orthophotography.
RSM - Sub-Region 01	Sub-Region 1 Coastal Points of Interest	rsm_dd_poi_01.shp	$RSMDD_HOME/_sediment_dd/feature/shape/regional/zone_01/	Points of Interest within Sub-Region 1

Creating Databases

A database is a collection of information related to a particular subject or purpose, such as tracking attribute description or maintaining a collection of GPS points. If your database isn't stored on a computer, or only parts of it are, you may be tracking information from a variety of sources that you're having to coordinate and organize yourself.

To store your data, create one table for each type of information you track. To bring the data from multiple tables together in a query, you define relationships between the tables.

A unique ID distinguishes one record from another. By adding one table's unique ID field to another table and defining a relationship, data from multiple tables can be brought together. For example, you can link a theme attribute table to an Access of Excel file, provided the tables share a mutual field.

Excel Databases

In Microsoft Excel, you can easily use a list as a database. When you perform database tasks, such as finding, sorting, or subtotaling data, Microsoft Excel automatically recognizes the list as a database and uses the following list elements to organize the data.

- The columns in the list are the fields in the database.
- The column labels in the list are the field names in the database.
- Each row in the list is a record in the database.

Access Databases (Creating New)

1. In Access, start with a blank database. (In Access, the term database or .mdb, is used to reference a collection of tables, queries, forms and reports.)
2. Click the Tables tab, and then click New.
3. Double-click Datasheet View. A blank datasheet with 20 columns and 30 rows is displayed. The default column names are Field1, Field2, and so on.
4. Rename each column you will use: double-click the column name, type a name for the column following Microsoft Access object-naming rules and then press ENTER.
5. If you need more than 20 columns, you can insert additional columns at any time: click in the column to the right of where you want to insert a new column, and then on the Insert menu, click Column. Rename the column as described in step 3.
6. Enter your data in the datasheet.
7. Enter each kind of data in its own column (each column is called a field in Microsoft Access). For example, if you are entering names, enter the first name in its own column and the last name in a separate column. If you are entering dates, times, or numbers, enter them in a consistent format so that Microsoft Access can create an appropriate data type and display format for the column. Any columns you leave empty will be deleted when you save the datasheet.
8. When you've added data to all the columns you want to use, click Save on the toolbar to save your datasheet.
9. Microsoft Access asks you if you want to create a primary key. If you haven't entered data that can be used to uniquely identify each row in your table, such as part numbers or ID numbers, it's recommended that you click Yes. If you have entered data that can uniquely identify each row, you can specify this field as your primary key.
10. Microsoft Access will assign data types to each field (column) based on the kind of data you entered. If you want to customize a field's definition further ¾ for example, to change its data type, or define a validation rule, use Design view.

Access Databases (Importing Existing Data)

You can import existing data from a spreadsheet (or just the data from a named range of cells), data from other Access databases or text files. Although you normally create a new table in Microsoft Access for the data, you can also append the data to an existing table as long as your spreadsheet column headings match the table's field names, or its column order is the same.

1. Open a database, or switch to the Database window for the open database.
2. To import a spreadsheet, on the File menu, point to Get External Data, and then click Import.
3. In the Import dialog box, in the Files Of Type box, select the type of file your are importing.
4. Click the arrow to the right of the Look In box, select the drive and folder where the spreadsheet file is located, and then double-click its icon.
5. Follow the directions in the Import Wizard dialog boxes.

Adding in Dynamic Tables (Microsoft Access) to ArcView

1. Using an ODBC Connection to connect to an Access database to create an ArcView table:
2. Make the Project window active.
3. From the Project menu, choose SQL Connect. The SQL Connect dialog appears.
4. The (ODBC) databases that are available to you are listed in the Connection box. Select the desired database.
5. Select the Connect button. The Login box will appear.
6. Type in the appropriate connection information in the new dialog box. When you see the Connect button gray out and the Disconnect button activate, you are connected to the database. A list of host database tables associated with that database will appear in the Tables box.
7. Select a Table from the Tables box. A list of columns from the selected table will appear in the Columns box.
8. Double-click on a column to select it. Columns selected will be included in the new database table. The name of the table and the name of the column, separated by a dot, will appear in the Select box.
9. Double click on a table from the Tables box to fill the From box. If you don't see the name of the table you want to use, type it into the From box directly.
10. If you would like to limit the number of records returned, you can use the Where box. For example, if you wanted all the records where a column had values greater than 0, click once in the Where window to activate it, double click on the column, then type " > 0".
11. If you are satisfied with the table, the column or columns you've selected, and optionally, a query, name the table, press the Query button. ArcView will create a table containing the records from the database.

NOTE: Values in a table created by connecting to a database cannot be edited in ArcView. To edit a copy of the data in one of these tables, you should export the table to a file on disk, and then add this file back into ArcView as a new table. You can now edit this new table.

Creating a Data Dictionary

The Data Dictionary contains names, descriptions and locations of each layer of information contained in, or accessed by, the GIS project. The presence of a Data Dictionary is a useful tool for organization of many layers of data.

Data Dictionaries are also a vital part to creating Avenue scripts to automate simple processes. A sample database and scripts has been included on this CD. Below is a description of the type of data to be entered in each field.

Group_Name	TOC	Common_Name	File_Name	Theme_Type	Feature_Class
RSM - Sub-Region 02	9	Project Maps	rsm_dd_map_02.shp	shape	point

File_Path	Description	Zoom_To_Scale
$RSMDD_HOME/_sediment_dd/feature/shape/regional/zone_02/	Project Map Location	4000

Legend_File	Legend_Path	Display_Theme
rsm_dd_cities_02.avl	$RSMDD_HOME/tools/avl/color/_sedimen	☒

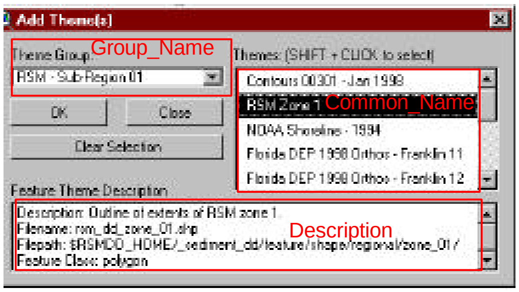
Metadata	HotLinkField	HotLinkScript
Proj_map.html	Proj_Map	RSM.Map.Hotlink

Field Name	Description
Group_Name	Group name given to layer. Must match a Group Name in the ArcView_Project_Groups table.
TOC	Order in which customized script should loaded theme. e.g., points & lines above polygons & images
Common_Name	Common name of file to appear in Table of Contents
File_Name	Name of file
Theme_Type	Type of theme—shape, georaster
Feature_Class	Class of theme—point, line, polygon, image, tin, grid
File_Path	Path to file
Description	Description of Dataset
Zoom_to_Scale	When themes are turned on, if scale is noted, display will automatically zoom to scale
Legend_File	Legend file name
Legend_Path	Path to legend file (use Environmental Variable instead of drive letter)
Display_Theme	When theme is loaded, will it automatically be displayed?
Metadata	Name of metadata for this file
HotlinkField	Field in Feature Attribute Table that contains filename to be hot linked
HotlinkScript	Customized script that launches the hot link file

Adding Data Dictionary to ArcView Projects

Create an ODBC connection to the Access Database
In ArcView, reference the Data_Dictionary in the SQL Connection Dialog
[Review ***What is ODBC and DSN?*** and ***Adding in Dynamic Tables (Microsoft Access) to ArcView*** sections in this document]

Custom Application Utilizing The Data_Dictionary



This dialog, created with ArcView's Dialog Designer, references the Data_Dictionary table. It allows the user to add in any layer that is related to this project in lieu of the Add Theme button.

When the OK button is clicked, ArcView queries the Data_Dictionary by the Common_Name. It reads the TOC, Legend_path and Legend_file fields from the Data_Dictionary and loads the appropriate files in the appropriate order.

*NOTE This is not out-of-the-box ArcView. This is a customized application designed by the Spatial Data Branch in the Mobile District. The required dialogs and scripts have been provided for you.

What is Metadata?

Metadata is frequently described as "data about data." Metadata is additional information (besides the spatial and tabular data) that is required to make the data useful. It is information you need to know in order to use the data. Metadata represents a set of characteristics about the data that are normally not contained within the data itself. Metadata could include

- An inventory of existing data
- Definitions of the names and data items
- A keyword list of names and definitions
- An index of the inventory and the keyword list for access
- A record of the steps performed on the data including how it was collected
- Documentation of the data structures and data models used
- A recording of the steps used on the data for analysis

Why Is Metadata Important?

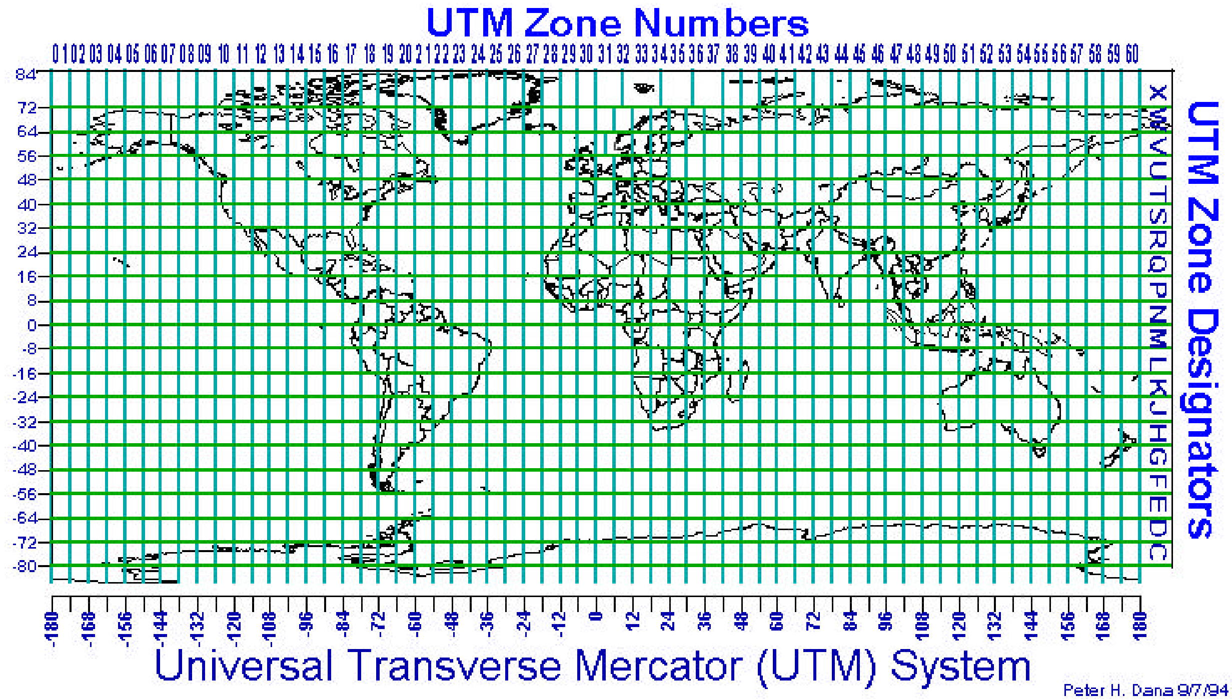
Spatial metadata is important because it not only describes what the data is, but it can reduce the size of spatial data sets.

Spatial data also supports software-based and organization-wide standards. The benefit of having software-based data standards is that the program is easier to use, and users can readily move data between systems and platforms. By creating metadata, you are creating a standard in naming, defining, cataloging, and operating standards for all departments. This in turn is a vital foundation for understanding, collaborating, and sharing resources with others.

Spatial metadata is important because it supports easier spatial data access and management. Metadata provides a guide to the casual and novice user's question, "How do I know what to ask for?" Metadata can provide information on what is available in an area of interest, where the information is, how current it is, what format it is in, and what use constraints apply. For spatial data professionals, metadata provides feature- and attribute item-level metadata management. This way, updates are easily accommodated and integrated into daily use of the data. Metadata is not an end in itself; it is a tool that will greatly improve your work with spatial data and increase your overall GIS benefits.

Appendix A

UTM Zones:



Metadata Sample:

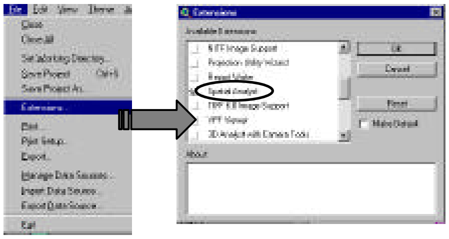
```
Identification_Information:
        Citation:
                Citation_Information:
                        Originator: Amantea Rilievi
                        Publication_Date: 19560000
                        Publication_Time: Unknown
                        Title: costa_1999.shp
                        Geospatial_Data_Presentation_Form: diagram
                        Series_Information:
                                Series_Name: Amantea Rilievi
                                Issue_Identification: 1999
        Description:
                Abstract: 1999 Survey Shoreline
                Purpose:
                        1999 Survey Shoreline

        Time_Period_of_Content:
                Time_Period_Information:
                        Single_Date/Time:
                                Calendar_Date: 19990600
                Currentness_Reference: Publication Date
        Status:
                Progress: Complete
                Maintenance_and_Update_Frequency: None planned
        Spatial_Domain:
                Bounding_Coordinates:
```

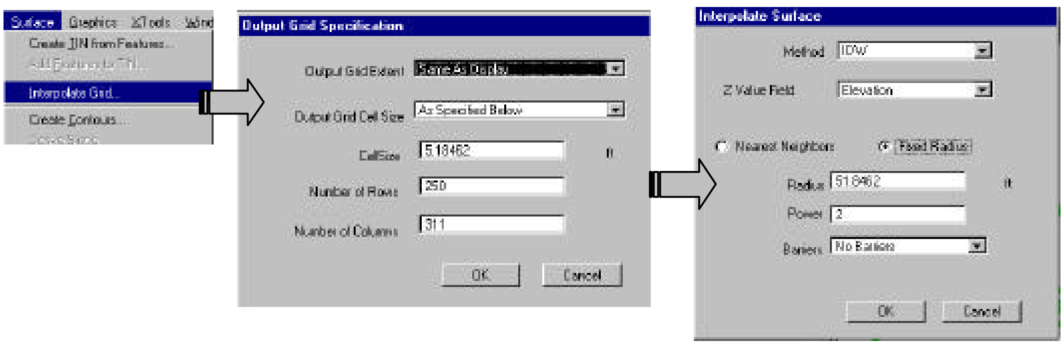
```
                        West_Bounding_Coordinate: +015.400000
                        East_Bounding_Coordinate: +016.100000
                        North_Bounding_Coordinate: +40.000000
                        South_Bounding_Coordinate: +39.000000
        Access_Constraints: None
        Use_Constraints: None
        Point_of_Contact:
                Contact_Information:
                        Contact_Person_Primary:
                                Contact_Person: Jen Irish
                                Contact_Organization: USACE
                        Contact_Position: Coastal Engineer
                        Contact_Address:
                                Address_Type: mailing and physical address
                                Address:
                                        USACE
                                        OP-J
                                        109 Saint Joseph Street
                                City: Mobile
                                State_or_Province: AL
                                Postal_Code: 36602
                                Country: USA
                        Contact_Voice_Telephone: 334-690-3465
Metadata_Reference_Information:
        Metadata_Date: 20010117
        Metadata_Review_Date: 20010117
        Metadata_Contact:
                Contact_Information:
                        Contact_Person_Primary:
                                Contact_Person: Rose Dopsovic
                        Contact_Address:
                                Address_Type: mailing and physical address
                                Address:
                                        USACE
                                        (OP-J)
                                        109 Saint Joseph Street
                                City: Mobile
                                State_or_Province: AL
                                Postal_Code: 36602
                                Country: USA
                        Contact_Voice_Telephone: 334-694-3107
        Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial
Metadata
        Metadata_Standard_Version: 1.3
```

Creating Grid Surfaces

1. If not loaded already, load the ***Spatial Analyst*** extension.



2. Select the Theme for which you would like to create a Grid Surface.
3. Zoom into your Active Theme and use the Measure tool to determine an approximate average distance between the points.



4. Go up to the ***Surface*** Menu and select ***Interpolate Grid…***

5. From the Output Grid Extent drop-down menu, select the name of the Active Theme.
6. If you have a predetermined cell size, fill in this box; else keep all of the defaults and click ***OK***.
7. In the Method drop-down menu, select ***IDW*** (Inverse Distance Weighted).
8. Select ***Elevation*** from the Z Value Field drop-down menu.
9. Select ***Fixed Radius*** and type in your ***average distance*** (from Step 3) in the Radius fill-in box.
10. Click ***OK*** and wait until it ends.
11. When finished edit Theme characteristics: specify number of classes, round to the nearest whole number, change the color ramp to lightest to darkest, sort the values descending, and create meaningful labels. Remember to save legend.
12. When finished, still have the Theme active, select the ***Theme*** menu and select ***Convert to Grid***. Save the grid to the ***Server*** in the appropriate folder and with the proper naming convention.

Know Errors:

Error	Resolution

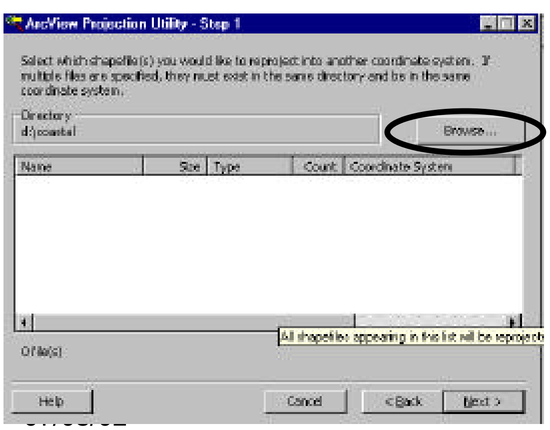
Segmentation Violation	Delete the "info" folder from your working directory. To find location of Working Directory, in the ArcView Project Window, from the Project Menu select Properties. Most likely $HOME will be your working directory. To determine the location of $HOME, • Click Start, point to Settings, click Control Panel, and then double-click System. • Click on the Environment tab Click on $HOME under the Systems Variable box. • The path will be listed below
GRID ERROR	Be sure that your Theme Attribute table contains X and Y fields. If not, download the XY extension and apply to point theme.

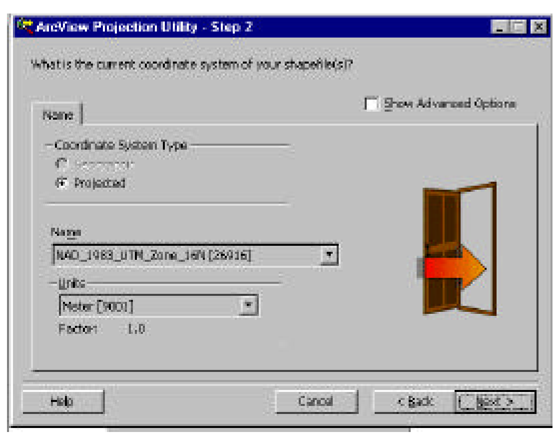
Reprojecting Shapefiles

***NOTE: Disable your Virus Scan before beginning.**

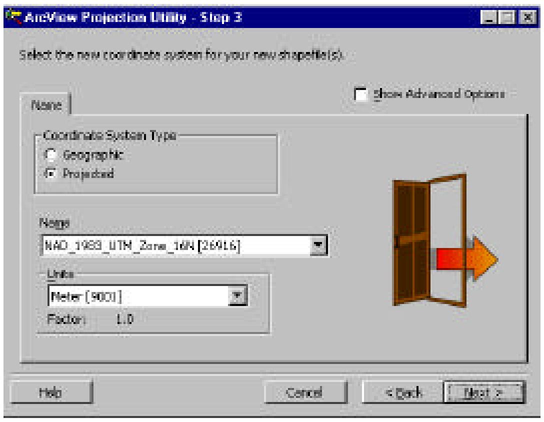
1. If not loaded already, load the ***Projection Utility Wizard*** extension. Click on the File menu and select Extensions…
2. Check Projection Utility Wizard and click OK.
3. Create a ***New View*** and run the Projection Wizard by clicking on the File menu and selecting ***ArcView Projection Utility***.

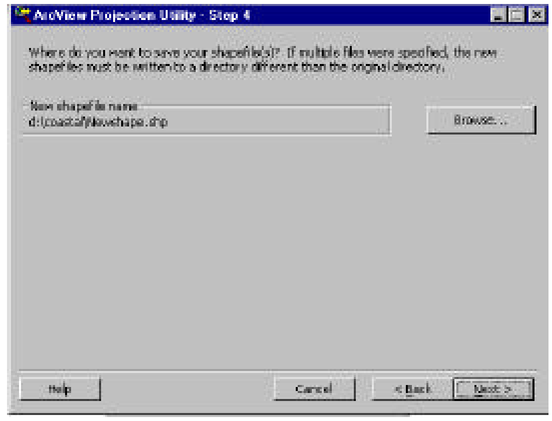
4. Click on the ***Browse*** button to find the shapefile(s) you wish to project, then click on ***Next***.





5. Fill in information about the ***current*** shapefile. Under Coordinate System Type, select ***Projected***.
6. For the Name drop down menu, select **the new projection.**
7. Then select what Units your shapefile uses, click ***Next***.





8. Follow steps 5-7 for your ***new*** coordinate system for your shapefile(s).
9. Click on the ***Browse*** button and choose a new location for the new projected shapefile, then click ***Next***.
10. A summary of the information you just inputted will be on the screen. Review this information. If all is correct, click on ***Finish***.

How to Make a Project Portable

1. Click on the Start Menu, Settings, Control Panel
2. In Control Panel, Select System
3. In the System Dialog Box, select the Environment tab
4. Click on the HOME variable (left side) and type in the “value” or location you would like your home directory to be. E.g., $Name
5. Click OK
6. Close all open windows
7. Open a Text Editor, such as Notepad or UltraEdit
8. Open your project, .apr file
9. Using a Search utility, find the word “path”.
10. Next to the word “path” you will see your original home location. Change the location to match what you typed in step 4.
11. Use Find & Replace to Replace you original home location with the new location.

*Note: In order for your project to be completely portable, you MUST use the same directory structures that are in your original project. Copy them exactly!

What to do with Lidar Data?

When Lidar data is ready to be incorporated into a GIS the file format is usually a simple ASCII file with 3 main elements: X, Y, and Z. ArcView is able to read these ASCII files as long as they are comma delimited and have an *.dbf or *.txt extension.

If the ASCII file is not comma delimited, they can be given this segmentation an number of ways.

Creating Comma Delimited files

In a Text Editor:

1. Open the text file.

2. Manually enter commas in to divided each column OR use the Replace option to find a space (or number of spaces) and replace with a comma.

3. Save text file. The file is now comma delimited and ready to be imported into ArcView.

In Excel:

1. Upon opening a text file, Excel automatically launches the "Import Text Wizard Dialog".

2. Follow the on-screen instructions. Select "Fixed Width" if columns are separated by spaces. Select "Delimited" if columns are separated by tabs.

3. When finished, save this Excel file as a *.dbf. The file is now comma delimited and ready to be imported into ArcView.

In Access:

1. Open a database, or switch to the Database window for the open database.

2. To import data, on the File menu, point to Get External Data, and then click Import.

3. In the Import dialog box, in the Files Of Type box, select Text Files.

4. Click the arrow to the right of the Look In box, select the drive and folder where the file is located, and then double-click its icon.

5. Follow the directions in the Import Text Wizard dialog boxes.

6. Select "Fixed Width" if columns are separated by spaces. Select "Delimited" if columns are separated by tabs.

7. When finished importing the table, right-click on this table, select "Save As/Export" and save as a *.dbf file. The file is now comma delimited and ready to be imported into ArcView.

Import Text Files into ArcView

To add an INFO, dBASE, or delimited text file to your project

1. Make the Project window active.

2. From the Project menu, choose Add Table

3. From the File Type list, choose INFO, dBASE (.dbf), or Delimited Text (.txt)

4. Navigate to the directory that contains the file you want to add.

5. Double-click the file you want to add or choose the file and press OK.

6. ArcView adds the table to your project.

NOTE: *Spaces, periods and other non-alphanumeric characters in file or directory names may cause problems. Underscores are the only non-alphanumeric characters that should be used. It is also recommended that you follow an 8.3 naming convention.*

How ArcView reads a delimited text file

When you add a delimited text file to your project ArcView displays it in a table by placing the text following each tab or comma in a separate cell for each line in the file. The first line in the text file is expected to be the field names for the table. Fields with values containing any characters that are not numbers are treated as strings. Fields with values containing only numbers are treated as numeric fields. Strings can either be quoted or unquoted. (If you want ArcView to read numeric values in as strings, enclose the numbers in quotes).

Here's an example of a comma-delimited text file that can be read into ArcView as a table with four fields, one of which is numeric, and five records:

```
City,Country,Annual sales,Sales person
London,England,45000,Rupert
Paris,France,32900,Maurice
Madrid,Spain,110000,Manuel
Lisbon,Portugal,34000,Cynthia
Glasgow,Scotland,15000,Robbie
```

Creating an Event Theme from Point files

ArcView 3.x

Simple point shapefiles can be created quickly and easily from existing X, Y, Z ASCII point files.

1. To create a point file, Add in the comma-delimited table (*.txt, *.dbf) in the ArcView Table window.

2. Go into a View and select the ***Add Event Theme*** option from the ***Theme*** menu.

3. Select your table and the X and Y columns from the respective drop-down lists.

4. When OK is selected, ArcView builds a point theme for the X,Y,Z points.

5. To convert this temporary theme to a shapefile, have the newly created layer active and select the Convert to Shapefile option from the Theme menu

ArcMap 8

1. To create a point file, Add in the comma-delimited table (*.txt, *.dbf) in the ArcMap layer. Right-click on imported table and select ***Display XY Data***.

2. Specify fields to use for X and Y columns using the respective drop-down lists.

3. A coordinate system can then be chosen by clicking on the ***Edit*** button.

4. To display the data in a standard coordinate system click on the ***Select*** button which will provide options.

5. The ***Import*** and ***New*** options are also available for setting the coordinate system.

6. After the coordinate system is selected click ***OK*** twice.

7. ArcMap then builds a point theme for the X,Y points.

8. To convert this temporary theme to a shapefile, right-click on the newly created theme and select ***Data*** from the drop-down menu. From the second drop-down box select ***Export Data***.

9. Save the file in the desired directory.

Creating a TIN

ArcView 3.x

A TIN can be created for the lidar data, provided that the 3D Analyst extension is installed and turned on. TINs provide a visualization of the elevation of lidar point data. Before a TIN can be built, a bounding polygon theme must be present defining the extent of the lidar point file.

1. Have both the Bounding Polygon and Lidar Point Themes Active.

2. From the Surface menu, select the "Convert TIN from Features" option.

3. Select the Lidar Point theme from the Active Themes list.

4. Be sure to check that the Elevation drop-down list, lists your Z or Elevation field.

5. Click OK and browse to the location to save this TIN.

ArcMap 8

1. In ArcMap, click the ***3D Analyst*** menu on the 3D Analyst toolbar. Point to ***Create/Modify TIN*** and click ***Create TIN From Features***.

2. Check the features that to be in used in building your TIN.

3. Use the

4. Click the drop-down arrow and choose the Height Source field.

5. Use the shape geometry tool if the features have 3D geometry.

6. Click the drop-down arrow and choose how the features should be incorporated into the TIN—as mass points, breaklines, or polygons.

7. Optionally, click the dropdown arrow and choose the Tag Value Field to tag the TIN features with a value from the input features.

8. Repeat steps 2 through 5 for each input feature class.

9. Type a name for the TIN.

10. Click OK.

Create a bounding polygon

ArcView 3.x

1. Use the Polygon tool to create a bounding polygon around the perimeter of the Lidar dataset.

2. If there are any holes or islands (such as no data zones, lakes, bridges, etc) in the data, use the Polygon tool to outline these areas.

3. Once all data has a bounding polygon, click on the ***Edit*** Menu and select "Select all graphics".

4. Click on the ***Edit*** Menu again and select "Combine graphics".

5. Click on the ***X-Tools*** Menu (if this menu is not present, turn on the XTools extension) and select, "Convert Graphics to Polygon".

6. Select "1 graphic polygon" and click OK to save the polygon.

7. Add the newly created polygon theme into view.

8. Hit the Delete key to delete the graphic line.

ArcMap 8

1. If not loaded already, load the ***XTools*** *(download from ESRI's support sire if necessary)* extension for ArcMap 8.

2. Start out by creating a polygon around the outside points of the shapefile.

3. If you dataset has "holes", or no data areas, also draw a polygon around these areas.

4. Select polygon sets of main polygon and null data areas. For each selected set, from the ***Drawing*** Menu, select ***Graphic Operations***, ***Remove Overlap***. This will "cut" a hole where the null data area reside.

5. If you have more than one polygon, group all of the graphics together. Select all of the graphics, and from the ***Drawing*** Menu, select ***Graphic Operations***, ***Union***.

6. Click on the ***XTools*** Menu and select convert shapefile to graphics.

7. Use this clip polygon shapefile for creating a TIN.

Creating a Grid

ArcView 3.x

1. If not loaded already, load the ***Spatial Analyst*** extension.

2. Select the Theme for which you would like to create a Grid Surface.3. Zoom into your Active Theme and use the Measure tool to determine an approximate average distance between the points.

3. Go up to the ***Surface*** Menu and select ***Interpolate Grid***…From the Output Grid Extent drop-down menu, select the name of the Active Theme.

4. If you have a predetermined cell size, fill in this box; else keep all of the defaults and click OK.

5. In the Method drop-down menu, select ***IDW*** (Inverse Distance Weighted).

6. Select Elevation from the Z Value Field drop-down menu.

7. Select Fixed Radius and type in your average distance (from Step 3) in the Radius fill-in box.

8. Click OK and wait until it ends.

When finished edit Theme characteristics: specify number of classes, round to the nearest whole number, change the color ramp to lightest to darkest, sort the values descending, and create meaningful labels. Remember to save legend.

ArcMap 8

1. Click the ***Spatial Analyst*** dropdown arrow, point to ***Convert***, and click ***Features to Raster***.
2. Click the ***Input features*** drop-down arrow and click the feature to be converted to a raster.
3. Click the ***Field*** dropdown arrow and click the field that will be copied to the Output raster.
4. Optionally, type an Output cell size.
5. Specify a name for the output raster or leave the default to create a temporary dataset in the working directory.
6. Click **OK**.

Tip

Click Options on the ***Spatial Analyst*** toolbar to set up your working directory, extent, and cell size for your analysis results

Creating a Grid from a TIN

ArcView 3.x

1. With the TIN theme Active, click on the View menu and select, "Convert to Grid"
2. Browse to location to save this Grid Theme.
3. When OK is clicked, define Output Extent and Cell Size. Click OK to complete the Grid theme.

ArcMap 8

1. In ArcMap, click the ***3D Analyst*** menu, point to ***Convert***, and click ***TIN To Raster***.
2. Click the drop-down arrow and click the TIN that is to be converted into a raster.
3. Click the Attribute drop-down arrow and click the attribute of the TIN that will be saved as a raster.
4. Choose from elevation, aspect, slope in percentage, and slope in degrees.
5. The TIN must have already been symbolized by the attribute in the map.
6. Optionally, set a z-factor.
7. Optionally, type the cell size for the raster.
8. Type a name for the Output raster.
9. Click OK.

Tip
The z-factor is used to convert the z units to the same scale as the x and y units if they are different.

Creating Contours

ArcView 3.x

1. Have either a Grid or TIN theme Active.
2. From the Surface menu, select ***"Create Contours"***
3. Enter the proper parameters and click OK.
4. Once the temporary Contour theme is created, from the Theme menu select, ***"Convert to Shapefile".***
5. Save this Contour shapefile in the proper location in the directory structure.

ArcMap 8

1. Click the ***Spatial Analyst*** dropdown arrow, point to Surface Analysis, and click ***Contour***.
2. Click the Input surface dropdown arrow and click the surface you want to contour.
3. Type a Contour interval to specify the distance between contours.
4. Type a Base contour from which to start contouring from or leave the default of 0.
5. Optionally, type a value for the Z factor.
6. Specify a name for the output or leave the default, which creates a permanent dataset in your working directory.
7. Click OK.

Tips

Use the ***Contour*** tool on the ***Spatial Analyst*** toolbar to create contours for specific locations in your input dataset.
Use the ***Select Features*** tool on the **Tools** toolbar to select contours, then open the table to examine the values. Alternatively, select contours from the table.